Paper / Subject Code: 37506 / FINITE ELEMENT ANALYSIS Date - 18/12/19

T.E. (Mechanical) (Sem-VI) (CBSGS)

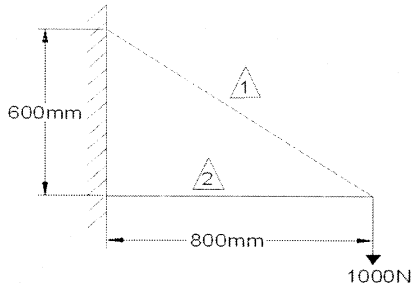
(3 Hours) Max. Marks: 80

Note:

1. Question 1 is Compulsory
2. Solve any three from the remaining five questions
3. Figures to right indicate full marks
4. Assume suitable data if necessary

Question No.		Max. Marks
Q.1	Attempt any **four**	20
	a) Compare Exact, Numerical and Experimental methods.	
	b) State and explain the principle of minimum potential energy.	
	c) Explain h and p type of meshing.	
	d) Differentiate between Weak and Non-weak form methods.	
	e) Explain Isoparametric and subparametric elements.	
Q.2	a) Compute nodal displacements, elemental stresses and strains for the truss as shown below using Finite Element Method. Take E=200GPa	10

Element	Area
1	50 mm^2
2	40 mm^2



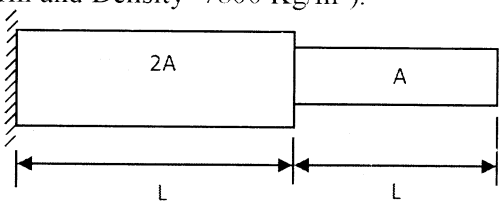
b) A copper fin of diameter 20mm, length 60mm and thermal conductivity is k=100 W/m°C and is exposed to ambient air at Ta=30°C with a heat transfer coefficient H=25 W/m^2 °C. One end of the fin is maintained at temperature 500 °C and other end is at 200 °C. Use RR method over general element to solve the following differential equation and obtain required EME. Take Lagrange's linear shape function and use one linear element. 10

$$kA\frac{d^2\theta}{dx^2} - Hp\theta = 0$$

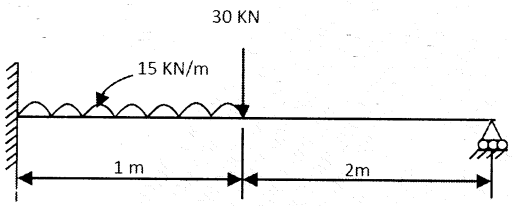
θ = Temperature difference = $T_x - T_a$

P = Perimeter of fin

Q.3 a) Find the natural frequencies of longitudinal vibrations of the constrained stepped shaft of areas A and 2A and of equal lengths (L), as shown below. Use consistent and lumped mass matrix approach. ($A=1m^2$, L=1m and Density=7800 Kg/m^3). 10



b) Find using FEA the deflection and slopes at nodes and reactions at supports for the beam as shown in figure. Take EI = 5000 KN-m^2. 10



Q.4 a) A CST element has nodal coordinates (10, 10), (70, 35) and (75, 25) for nodes 1, 2 and 3 respectively. The element is 2 mm thick and is of material with the properties E = 70 GPa. Poission's ratio is 0.3. After applying the load to the element the nodal deformation were found to be $u_1 = 0.01mm$, $v_1 = 0.04mm$, $u_2 = 0.03mm$, $v_2 = 0.02mm$, $u_3 = -0.02mm$, $v_3 = -0.04mm$. Determine the strains e_x, e_y, e_{xy} and corresponding element stresses. 12

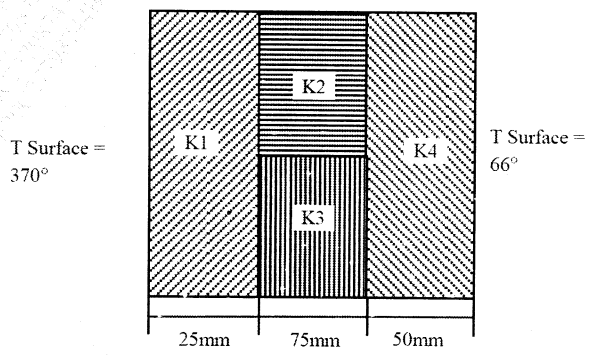
b) 8

i) Explain patch test in FEA.
ii) Explain the sources of errors in FEA.

Q.5 a) What is serendipity element? Derive the shape function for four noded rectangular element using NCS. 10

b) Find the heat transfer per unit area through the composite wall as shown in figure below. 10

K1 = 150 w/m-°C
K2 = 30 w/m-°C
K3 = 70 w/m-°C
K4 = 50 w/m-°C



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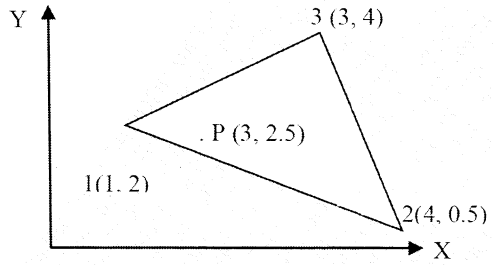
Q.6 a) Solve the following differential equation using Galerkin and Subdomain Method 10

$$-\frac{d}{dx}\left[(x-1)\frac{du}{dx}\right] = x^2; 3 \le x \le 5$$

Boundary condition: u(5)=10 and (du/dx)(3)=5. Compare the answers with exact solution at x=4.

b) The nodal coordinate of the triangular element for ground water simulation is as shown in figure. The nodal values of hydraulic heads (ϕ) at the nodes are (4.5, 2.3, 4) respectively. Find the value of the hydraulic head at point P. 10



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